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THE ROYAL ASTRONOMICAL SOCIETY OF CANADA

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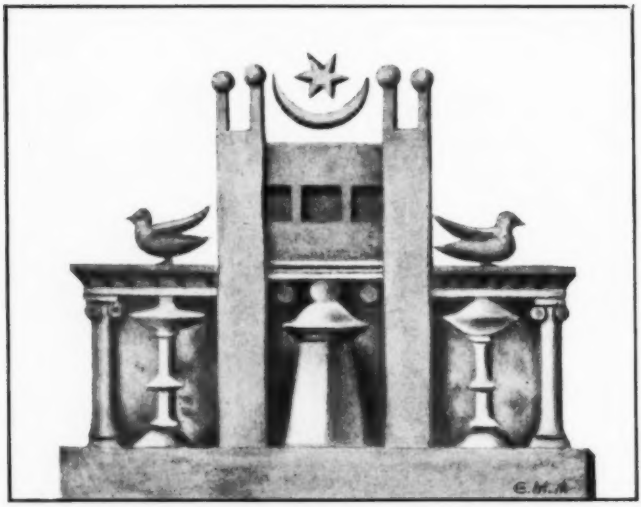
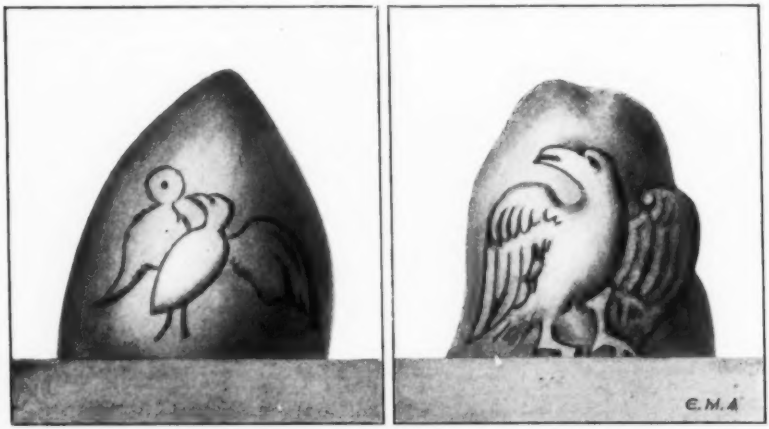


Fig. 1.—A front view of the Temple of Aphrodite at Paphos, in Cyprus, showing in the middle the Pyramidal Meteoric Idol of the Goddess, whose Planet is seen at the top in the arms of the Crescent Moon. (From an old coin of Cyprus.)

Fig. 5.—A coin of Byzantium, of the IIIrd century of the Christian era, showing the Lunar Crescent with a brilliant Star in its centre.

Fig. 2.—An imperial coin of Emesa, in Syria, showing the celebrated conic Aërolith on a quadriga. This Meteorite was considered as an Emblem of the God Sun; and the youthful Emperor Heliogabalus wished it to be the Supreme Deity of the Roman Empire. (The coin was drawn on a large scale by the writer.)



Figs. 3 and 4.—Two different representations of the Emesa Aërolith. The first is an enlargement from Fig. 2; the second, after another coin. The Meteorite was accompanied by the image of an Eagle, considered as a faithful attendant of the Deity, and an emblem of the majesty and power of the King of the Universe.

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ON ANCIENT METEORITES, AND ON THE ORIGIN OF THE CRESCENT AND STAR EMBLEM

By E. M. ANTONIADI
(with Plates VII and VIII)

I. THE OLD AEROLITHS* OF THE FAR EAST

ASTRONOMICAL treatises do not describe the meteoric stones of antiquity. To fill this gap is the object of the present paper.

Aërolithe were called *bætyli* in olden time. Thus the patriarch Photius informs us that "Asclepiades ascended Mount Lebanon, near Heliopolis, in Syria", and that "he saw there many of the so-called . . . bætyli, concerning which he narrates countless prodigies".[1] And, according to Eusebius Pamphilus, "the god Uranus conceived the bætyli, thus creating souled stones".[2] The same author also states that "Astarte, . . . travelling over the earth, found a star that had fallen from heaven; she picked it up and consecrated it in the holy island of Tyre. The Phœnicians say that Astarte is Aphrodite", or Venus.[3]

Plutarch calls attention to the "invisible stones that often fall on the earth, where they are extinguished, like the stony star which came down in fire at Ægos Potamoi".[4]

We find in Pliny the Elder the following statement: "I myself

*Professor Antoniadi prefers the form *aerolith* to the more commonly used *aerolite*. This corresponds to the French *aërolithe*, derived from the Greek yiOoS. The Oxford Dictionary, however, attributes our use of *lite* instead of *lith* in mineralogy to the influence of the French geologists.

[1] *Myriobiblon*, 342 *b*.

[2] *Evangelical preparation*, I, 36.

[3] *Ibid.*, I, 37.

[4] *Of things pleasing philosophers*, II, 13.

saw a stone that had just fallen in the territory of the Vocontians", in south-east Gaul.[5]

It was believed by the ancients that the meteorites were falling from Jupiter; not from the planet of that name, of course (although three geometricians curiously consider him to dart forth the vastly bulkier nuclei of the comets of his family), but from the great deity of Paganism, that is to say, from heaven. We can thus understand the profound reverence that was done them for long centuries in the Near East.

The Meteorite of Paphos, an Idol of Aphrodite.—Homer narrates that the goddess "Aphrodite, who likes smiling, flew to Cyprus, to Paphos, the seat of her sanctuary and perfumed altar".[6] This passage concerns the Ancient Paphos, a town once situated near the south-western coast of the isle of Cyprus. In the temple of Aphrodite of that town, "the representation of the goddess," says the great Roman historian Tacitus, "has no human form: it is a rounded block, larger at the base, and narrowing up to the summit, like a cone. The reason for this figure is unknown".[7] Maximus of Tyre likens the idol to "a white pyramid";[8] and, in spite of this colour, which might perhaps have been due to painting, there can be no doubt that we have to deal here with a meteorite, which has been often represented on numerous coins of Paphos.

Meteorites of Mons Albanus, which fell in about 640 B.C.—Titus Livius relates that after the destruction of Alba, "they announced to the king [of Rome, Tullus Hostilius], and to the senators, that a shower of stones had fallen on the Alban mountain".[9]

The Large Meteorite that fell at Ægos Potamoi in about 469 B.C.—Aristotle speaks of the time "when the stone of Ægos Potamoi fell down".[10] Ægos Potamoi, or Rivers of the Goat, were streams of the Thracian Chersonesus, rendered famous by the surprise victory of

[5] *Naturalis historia*, II, 59.
[6] *Odyssey*, VIII, verses 362-3.
[7] *Ab excessu Augusti*, II, 3.
[8] *Colloquies on the first sojourn in Rome*, II, 8.
[9] *Ab urbe condita*, I, 31.
[10] *Things above the earth*, I, 7, 9.

the Lacedæmonian fleet over the Athenian in 405 B.C. According to Plutarch, "once the stone had fallen with all its weight, the natives, being no longer afraid, nor astonished, assembled on the spot of the fall and witnessed an incomparable phenomenon with traces of fire, a large stone that lay on the ground".[11] And again, "in conformity with the testimony of many people, there fell from the sky a very large stone at Ægos Potamoi; and it is shown even now, venerated by the Chersonites".[12] Pliny asserts that "its weight can load a chariot", and that it has "the colour of something burnt".[13] Lastly, Plutarch adds that "it is said that Anaxagoras had predicted this fall",[14]—a statement which is manifestly exaggerated.

Meteorite of Rhea, or Cybele, at Pessinous.—Titus Livius describes as follows the reception of the Roman deputies by Attalus I, king of Pergamon, in the last years of the IIIrd century B.C.: "The prince accorded them a kindly reception, led them to Pessinous, in Phrygia, handed them a sacred stone that was considered by the inhabitants to be the mother of the gods, and advised them to transport it to Rome".[15] And "they say", writes Herodian, "that her idol fell from Jupiter. . . . It is believed that it came down from heaven in the olden time in a region of Phrygia (whose name is Pessinous, thus named from the sky-fallen idol) where it was first seen".[16]

Arnobius describes it as "a stone which is really not large, and which can be held in the hand. . . . Its colour is coal black and very dark, and it has irregular, protruding angles. . . . It also shows a vague resemblance to a face".[17]

Meteorite of Abydos.—"In the gymnasium of Abydos", says Pliny, "a stone is revered even to-day on account of this [celestial] origin. Its volume is mediocre".[18]

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[11] *Lysander*, 12. Chambers spells erroneously the locality as the River Negos.

[12] *Ibid.*, 12.

[13] *Op. cit.*, II, 59.

[14] *Op. cit.*, 12.

[15] *Ab urbe condita*, XXIX, 11.

[16] *Histories posterior to the reign of Marcus*, I, 11.

[17] *Disputationes adversus gentes*, VII, 46.

[18] *Op. cit.*, II, 59.

Meteorite of Potidæa.—The same author further states that "a stone is also venerated at Cassandria, named Potidæa, which was colonized for this reason".[19]

Shower of Stones on Mons Aventinus, in Rome, in about 190 B.C. —According to Julius Obsequens, "a shower of stones fell on Aventinus".[20]

Other Showers of Meteorites in Italy, from about 154 to 93 B.C. —Obsequens then mentions showers of stones at Aricia in 154; in Tuscany in 104; in the country of the Vestinians in 96; in the country of the Volscians in the same year; and again in the territory of the Vestinians in 93.[21] Stony showers were thus very plentiful in Italy in those times!

Fall of a Large Meteorite in Rome, in about 90 B.C.—We further read in the book of the same author that "a large heavenly body fell" near the place where the senate was assembling.[22] But Obsequens is often a mythographer, so that his statements have not the solidity of the Greek texts that I have translated in this paper.

The famous Meteorite of Emesa, in Syria, considered as an Emblem of the God Helios, or the Sun.—Herodian informs us that "Bassianus [Varius Avitus, who became the emperor of Rome known as Heliogabalus under the usurped name of the illustrious Marcus Aurelius Antoninus] and Alexianus [his cousin, who became the emperor Alexander Severus] . . . consecrate themselves to the god Helios; for the latter is venerated by the people of the country [of Emesa], who call him Elæagabalus in the Phœnician language.[23] And they built for him a very great temple, adorned with gold, silver, and splendid marbles. In this shrine there is no statue sculpted by the hand of man, and representing some deity, as with the Greeks and

[19] *Ibid.*, II, 59.

[20] *Prodigia*, LVI.

[21] *Ibid.*, LXXVII to CXIV.

[22] *Ibid.*, CXVII.

[23] Gibbon says that this word is derived by the learned from two Syriac words, *ela*, a god, and *gabal*, to form, "the forming or plastic god, a proper, and even happy epithet for the sun" (*The History of the Decline and Fall of the Roman Empire*, ch. VI).

Romans; but one sees a very large stone, round at the base, and ending in a point. Its form is conical, its colour black. They affect to consider this stone as having fallen from Jupiter, and they show on it some small projections and cavities. They presume to see in it a rough representation of Helios. Bassianus filled the sacerdotal duties of this god".[24]

It is a well-known fact that Heliogabalus made his solemn entrance in Rome, dressed like a Phœnician priest and carrying in a cart the famous black stone, a yard long, of Emesa. Herodian relates that the young prince "raised a very large and most beautiful temple to the god [that is to say to the aërolith], and elevated around it a great number of altars".[25] Lampridius asserts that the "god Heliogabalus was consecrated on Mount Palatine, near the imperial palace".[26] The extravagant emperor, for whom, as Gibbon remarks, "the display of superstitious gratitude was the only serious business", then married this meteoric god to the idol of the goddess Astarte of Carthage: "He sent to fetch the statue of the Celestial, which the Carthaginians and Libyans revere quite particularly, . . . and who call her Celestial, while the Phœnicians name her Astroarch [or Queen of the stars], wanting her to be the Moon. For Antoninus [Heliogabalus] was saying that it became the Sun to espouse the Moon".[27]

Herodian informs us at last that Heliogabalus "raised in a suburb [of Rome] a very large and most sumptuous temple, where he carried the god every year, in midsummer. . . . And having placed this god [the aërolith] on a chariot adorned with gold and the most precious stones, he transported him from the town to the suburb. He thus led this car, which was drawn by six spotless white horses of the largest size, set off with much gold, and variously caparisoned, and himself held the reins. Nobody ever mounted on the chariot, the attendants keeping round the prince while he led the god. Antoninus [Heliogabalus] ran backwards before the car,[28] constantly looking at the

[24]*Op. cit.*, V, 3, 4-6.

[25]*Ibid.*, V, 5, 8.

[26]*Antoninus Heliogabalus*, III.

[27]*Op. cit.*, V, 6, 3-5.

[28]Herodian indulges here in a pleonastic expression, meaning in English that Heliogabalus "ran, receding backwards." He evidently intended, by this

god, and holding the reins. He thus went over the whole extent of the road, running backwards, and staring at the face of the [meteoric] god. And in order that he might not fall backwards, or slip, for he was not seeing where he was going, the way was strewed with gold dust. The guards who protected the prince were watchful that such a race should end without accident; and the people, who also ran on either side of the retinue, formed a varied procession of torch-bearers, who threw wreaths and flowers" on the chariot.[29]

Lampridius asserts that this emperor "resolved to raise an immense column, ascendable by inner steps, and carrying the god Heliogabalus". And "he wanted Heliogabalus to be the only deity adored everywhere, . . . all gods being his ministers".[30] It has been aptly remarked that there was an interesting monotheistic idea in this worship.

Small Meteorite of Emesa.—According to the patriarch Photius, a certain Eusebius saw on a night, near Emesa, "a fiery ball, suddenly falling from the sky"; and on running to the spot, he found "the ball already extinguishing its fire". He picked up this bætylus, "which was whitish in colour, and which had the diameter of a span".[31]

Meteorites of Laodicea.—We further read in Lampridius that "Heliogabalus wished to withdraw from the temple of Diana of Laodicea, and from the sanctuary where Orestes had placed them, the stones that are called divine".[32]

The celebrated Meteorite of Mecca.—Maximus of Tyre, writing on the religion of the Arabians towards 150 A.D., has the following passage: "I do not know whom the Arabs worship; but I *did* see the

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pleonasm, to lay stress on the foolishness of the feat of the emperor. Gibbon represents here Heliogabalus as moving "slowly backwards that he might perpetually enjoy the felicity of the divine presence." Indeed, the prince, as above stated, *ran* backwards. I seize this opportunity to express my highest admiration for the wonderful general accuracy, majesty of style, and incomparable flow of language of the immortal English historian.

[29] *Op. cit.*, V, 6, 6-8.

[30] *Op. cit.*, XXIII, VI, and VII.

[31] *Op. cit.*, 348 *ab*.

[32] *Op. cit.*, VII.

idol: it is a square stone".[33] About half a century later, Clemens of Alexandria remarked that "the Arabians adored the stone".[34] And "you will laugh", says Arnobius, "when thinking that in ancient times the Persians venerated the rivers, . . . the Arabs an amorphous stone".[35]

The most sacred object of worship in the Kaaba of Mecca is the black stone, believed to have been brought on earth by the archangel Gabriel in order to form the foundation of the Arabian temple. It is a small, irregular mass, 7 inches long, and reddish brown in colour. The original roughness of its surface has been smoothed during so many centuries by the countless kisses of the faithful as well as by those of the pilgrims. According to Sale, it is considered by some as the right hand of God on earth; and they fable that it is one of the precious stones of paradise, which fell down to the earth with Adam.[36] The most marvellous properties are attributed to this aërolith: that it floats in water; that it instantly fattens the leanest camel which bears it; and that such is its weight, that several horses can not move it at all.

II. The Crescent and Star Emblem

At the top of the temple of Aphrodite at Paphos, represented in the first illustration of this paper, we find the crescent of the Moon bearing a brilliant star in an impossible position, in its very centre. An indication of the origin of this symbol seems furnished by Stephen of Byzantium. In 339 B.C., Philip of Macedon, the father of Alexander the Great, beseiged Byzantium, but was repulsed from the walls of the city after a long struggle. "Bosporian," says Stephen, "is the harbour of Byzantium. But the natives call it Phosphorian, altering the spelling of the name, as they remembered that Philip the Macedonian had dug during the siege a concealed entrance whence the diggers were to ascend invisible from the excavation, and that Hecate being brilliant, caused torches to appear at night to the citizens, who, having been delivered from the siege, called the place

[33] *Op. cit.*, II, 8.
[34] *Exhortative discourse to the Greeks*, IV, 3-4.
[35] *Op. cit.*, VI, 11.
[36] *The Koran*, preliminary discourse, ed. of 1825, vol. I, p. 161.

Phosphorian.[37] Now, the triple goddess Hecate is here the Moon in her sympathetic figure; and in the sentence which I have translated as "Hecate being brilliant", the Greek adjective is *phosphoros,* meaning literally "light-bearer", hence "luminous", "brilliant", or even "torch-bearer". Were the word to be written with a capital initial, *Phosphoros,* then it would be one of the names of the planet Venus; but then the sentence "Hecate being Aphrodite" could scarcely stand, even in the most laconic style. And yet the absolute identity in pronunciation of the adjective and of the name of the brilliant planet constitutes here a highly curious and perplexing coincidence.

Mr. Oman, of Oxford, in his excellent work on the Eastern empire, remarks that "the sudden appearance of the light in heaven, which revealed the advancing enemy, . . . was taken by the Byzantines as a token of special divine aid. . . . In commemoration of it they assumed as one of their civic badges the blazing crescent and the star, which has descended to our own days and is still used as an emblem by the present owners of that city—the Ottoman Sultans".[38]

Several Byzantine coins show the crescent and star; and it seems highly probable that a close conjunction of the planet Venus with the Moon occurred 23 centuries ago at the time of the deliverance of the city. And thus, whatever interpretation be given to the foregoing passage of Stephen the Byzantine as it came down to us, the star in the centre of the meniscus *must* have been intended for Venus; and this the more so as the very same emblem crowned the most celebrated shrine of that goddess.

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[37] *National questions,* Bosporus.

[38] *The Byzantine Empire,* London, 1892, p. 7-8.

A. H. YOUNG'S SIMPLE MOUNTING FOR THE 6-INCH REFLECTOR

By H. Boyd Brydon

I

SINCE the publication of the articles on Telescope Mountings for Amateur Builders[1] letters have been received commending and condemning the designs illustrated. Others, more constructively, mention the need of a simpler mounting than these shown for the 6-in. telescope of the beginner.

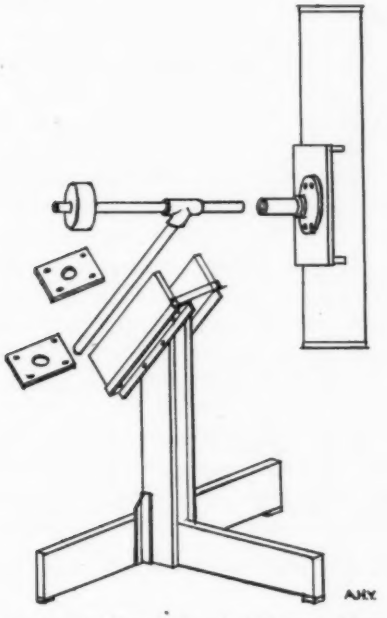

Fig. 1.—A. H. Young's Simple Telescope Mounting.

This need is well satisfied by a mounting recently developed in

[1]This Journal, vol. 30, 1936, p. 377; vol. 31, 1937, p. 4*ff*.

Victoria. It is simple to build, requires a minimum of machine work, it is light, it is very portable and it is steady when set up for use. Designed and first built by Mr. A. H. Young, it was introduced by him to Victoria Centre during his lecture on Telescope Making, delivered in August last. It has been built from drawings with complete success in Quebec by one who describes himself as "an absolute beginner in star-gazing, never having seen a telescope and not of a mechanical turn of mind," yet in reporting the completion of his telescope and its mounting, ready for circles and clamps, "fifteen

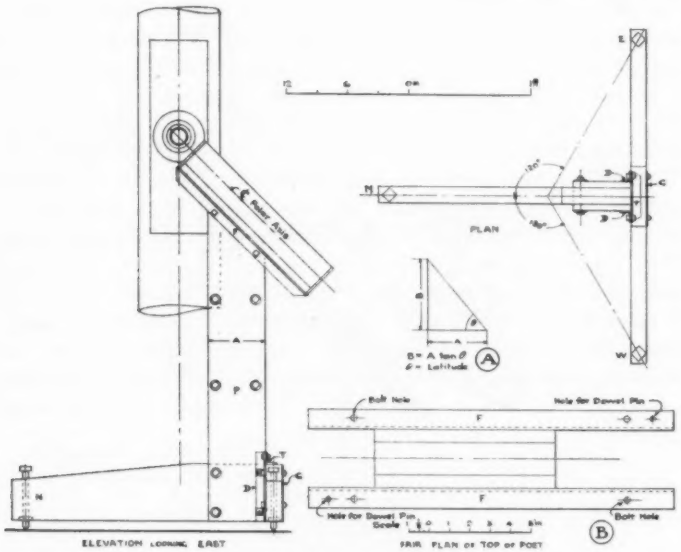

Fig. 2.—Portable Stand for Young Mounting.

minutes too late for the eclipse of the moon" he says—"Mr. Young's mounting is so easy and satisfactory for a beginner to build I think it should have some publicity. I am sure that there are others in the same boat as myself to whom this mounting would be a cinch to make

whereas others which are more complicated would scare them."[2] With the consent and co-operation of Mr. Young whose suggestions and advice have been most valuable in its preparation a description of this useful mounting is presented.

The essential parts of the mounting are shown in Fig. 1. The wooden base or stand, Fig. 2, consists of a post *P* supported by three projecting feet, *N*, *E* and *W*, in the form of a T, (see plan). The post is built up of three pieces bolted together. The middle one is 2 x 6-in. and the two outside pieces 1 x 6-in. nominal dimensions. The middle piece stops against the north foot, *N*, which extends through the post and is bolted between the two side pieces. Half-inch bolts turning in nuts let into the underside of the feet serve to level the stand. The east and west feet are formed by a single board attached by bolts to the angle irons *D*, *D*. The board is removed for transportation. There is little chance of the nuts being lost or forgotten if they are always replaced on the bolts as soon as the board is removed. To insure that the board shall be square with the post when in place, the top edge bears against an angle iron *T* and the bolt heads bear on a single plate of No. 14 iron *G* screwed to the board instead of on separate washers.

The top of the post is carefully finished to the angle corresponding to the latitude of the place of observation. The angle is most easily marked out by means of its tangent (see Fig. 2*A*). One inch by ⅛-in. angle irons *F*, *F*, are screwed to the sides of the post flush with the inclined top. A fair plan of the top with the angles in place is shown in Fig. 2*B*.

The polar axis is carried in steel plate bearings forming the ends of a shallow wooden box or trough *A*, Fig. 3*A*. The box with the complete mounting in place is bolted to the angle irons flanking the top of the post when setting up the telescope and is removed for transportation. Two ¼-in. dowel pins *B*, *B*, Fig. 3, fitting holes in

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[2]This 6-in. telescope has an aluminized mirror and diagonal and one eyepiece. The total present cost including materials and machine work for the mounting, also freight, etc., is given as $21.06. Estimating the cost of an additional eyepiece or two and the circles and clamps, a most useful instrument will have cost some $30.00—$35.00 complete.

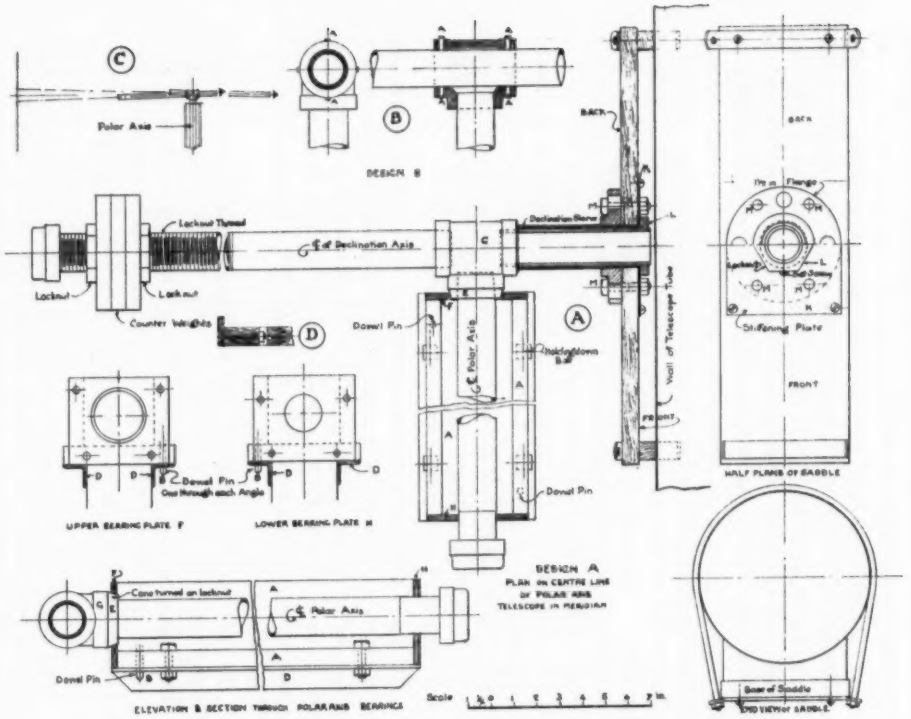

Fig. 3.—Details of Polar and Declination Axis, Young Mounting.

these angles insure the box always taking the same position when placed on the post.

The following method is recommended for setting the dowel pins correctly. The dowel holes having been drilled in the angle irons, *F F* Fig. 2, *D D* Fig. 3, the box is set correctly in place and the nuts tightened on the holding down bolts. Through each dowel hole a ¼-in. drill is then entered for about ½-in. into the base board and side pieces of the box, then with a ⅛-in. drill the hole is deepened to about 1½-in. in the wood. Without disturbing the setting of the box a drop of "Seccotine" or other strong glue is put into each hole, a No. 14, 2-in. steel wood screw turned in tight and the head cut off leaving about ¼-in. to ⅜-in. of the shank outside the angle iron. The end is then rounded with a file and the dowel is finished.

The upper bearing plate, *F*, Fig. 3, for the polar axis, is bored taper to fit a cone turned on the locknut *E* shown next the tee *G*. The lower bearing plate *H*, is bored 1⅝-in. diameter.

Nails should not be used in building the stand. Through bolts with large washers under head and nut should be used wherever possible. For instance, the bearing plates *F*, *H*, are preferably secured to the bottom and sides of the box *A* by four 2-in. stove bolts, the nuts being put on through holes drilled as in Fig. 3*D*. Otherwise 1½-in. No. 10 counter sunk wood screws may be set into the wood with seccotine.

Turning now to the moving parts of the mounting, a list is given below of the pipe and fittings needed. All pipe is "standard weight black pipe," fittings are cast or malleable iron, "standard weight, screwed." The tee is preferably of the "banded" pattern. Except where specified in the list all pipe threads are to be carefully cut in a pipe threading machine. Hand cut threads must not be used. They cannot be relied upon for squareness. All cut pipe is to be reamed at ends to remove burrs.

As it is of primary importance for the right performance of the mounting that the polar and declination axes be perpendicular to one another and because available facilities may make one or other preferable by the builder, two designs *A* and *B* are given for the declination axis. In *A*, squareness depends upon accurate machine work during construction; in *B*, any error here can be corrected later. The list shows at *A* and *B* the material correspondingly required.

List of Pipe and Fittings Required

For either design

Polar axis. 1 pce. 1¼-in. pipe 18-in. long, one end threaded standard, other end threaded ½-in. longer than standard to allow for a locknut.

Declination axis sleeve. 1 pce. 1½-in. pipe 5¼-in. long, one end plain, other end threaded ¾-in. longer than standard; (i.e. the thickness of the base of the telescope saddle, see Fig. 3).

Fittings. 1 only 1¼-in. tee, "banded" pattern
2 only 1¼-in. caps
4 only 1¼-in. locknuts
1 only 1½x5-in. standard cast iron companion flange, faced and drilled.

For design A only

Declination axis formed of two pieces of pipe.

Short arm. 1 pce. 1¼-in. pipe 6½-in. long, both ends threaded standard. Threads cut in lathe.

Counter balance arm. 1 pce. 1¼-in. pipe 21-in. long, one end threaded standard, the other end with a locknut thread 12-in. long.

For design B only

Declination axis formed of one piece of pipe.

Declination axis. 1 pce. 1¼-in. pipe 30-in. long, one end threaded standard, other end with a locknut thread 12-in. long.

In both designs the saddle carrying the telescope is bolted to the 1½-in. flange with four 5/16-in. bolts *M, M,* spaced as shown in Fig. 3. The flange is screwed tightly onto the 1½-in. pipe sleeve and the end projecting beyond the face of the flange is cut off corresponding to the thickness of the base of the saddle. A locknut *L* on the declination axis, secured by a set screw, holds the sleeve in place so that it can turn easily, smoothly and without end play on its bearing, the short arm of the declination axis. A brass washer between the end of the sleeve and the tee adds to the smoothness of operation. In an early model, a friction device in the form of a heavy rubber washer, which also served to prevent end play, was used to control the motion of the telescope in declination. A clamp of strap iron embracing a small drum is more effective and satisfactory as it is positive in action and is not injured by oil or grease from the sleeve bearing.

The following procedure is recommended when machining the parts.

DESIGN A

1. *Declination sleeve.* Drill the 1½ x 5-in. flange as shown for the saddle bolts and screw tight onto pipe. Ream the pipe to 1⅝-in. diameter. Face both ends square and true to length.

2. *Declination axis, short arm.* In machining this piece and the polar axis, every precaution must be taken to insure that the bearing for the declination sleeve shall be square with the polar axis. Mount the piece for the short arm on cone centres in the lathe and cut both threads. Screw tight into run of tee. Centre again and turn the bearing to a nice running fit in the sleeve.

3. *Polar axis.* Run on the locknut. Screw the pipe tight into outlet of tee. Back the locknut tight against tee. Centre in lathe. When in centres but before the polar axis journals are turned the squareness of the machined declination axis should be checked by the chuck or face plate. If slightly out of square the polar axis can be bent to correct this. When checked turn the cone on the locknut for the upper journal and the pipe 1⅝-in. diameter for the lower journal.

DESIGN B

1. *Declination sleeve.* Proceed as for design A.

2. *Declination axis.* Mount on cone centres in the lathe and turn the bearing for declination sleeve.

3. *Tee.* Ream the run to 1 11/16-in. diameter. Drill and tap the run bands for four 3/16-in. flat ended centering screws in each. See Fig. 3*B*.

4. *Polar axis.* Run on the locknut. Screw the pipe tight into outlet of tee. Back the locknut tight against tee. Centre in lathe and turn the cone on the locknut for the upper journal and the pipe 1⅝-in. diameter for the lower journal.

5. Pass declination axis through run of tee to correct position lengthways. Adjust the centering screws until it is square with the polar axis. When proved correct, paint the sleeve bearing to prevent rusting and pack full the space surrounding the declination axis within the tee with neat portland cement, mixed fresh with water to

List of Pipe and Fittings Required

For either design

Polar axis. 1 pce. 1¼-in. pipe 18-in. long, one end threaded standard, other end threaded ½-in. longer than standard to allow for a locknut.

Declination axis sleeve. 1 pce. 1½-in. pipe 5¼-in. long, one end plain, other end threaded ¾-in. longer than standard; (i.e. the thickness of the base of the telescope saddle, see Fig. 3).

Fittings. 1 only 1¼-in. tee, "banded" pattern
2 only 1¼-in. caps
4 only 1¼-in. locknuts
1 only 1½x5-in. standard cast iron companion flange, faced and drilled.

For design A only

Declination axis formed of two pieces of pipe.

Short arm. 1 pce. 1¼-in. pipe 6½-in. long, both ends threaded standard. Threads cut in lathe.

Counter balance arm. 1 pce. 1¼-in. pipe 21-in. long, one end threaded standard, the other end with a locknut thread 12-in. long.

For design B only

Declination axis formed of one piece of pipe.

Declination axis. 1 pce. 1¼-in. pipe 30-in. long, one end threaded standard, other end with a locknut thread 12-in. long.

In both designs the saddle carrying the telescope is bolted to the 1½-in. flange with four 5/16-in. bolts *M, M,* spaced as shown in Fig. 3. The flange is screwed tightly onto the 1½-in. pipe sleeve and the end projecting beyond the face of the flange is cut off corresponding to the thickness of the base of the saddle. A locknut *L* on the declination axis, secured by a set screw, holds the sleeve in place so that it can turn easily, smoothly and without end play on its bearing, the short arm of the declination axis. A brass washer between the end of the sleeve and the tee adds to the smoothness of operation. In an early model, a friction device in the form of a heavy rubber washer, which also served to prevent end play, was used to control the motion of the telescope in declination. A clamp of strap iron embracing a small drum is more effective and satisfactory as it is positive in action and is not injured by oil or grease from the sleeve bearing.

The following procedure is recommended when machining the parts.

DESIGN A

1. *Declination sleeve.* Drill the 1½ x 5-in. flange as shown for the saddle bolts and screw tight onto pipe. Ream the pipe to 1⅝-in. diameter. Face both ends square and true to length.

2. *Declination axis, short arm.* In machining this piece and the polar axis, every precaution must be taken to insure that the bearing for the declination sleeve shall be square with the polar axis. Mount the piece for the short arm on cone centres in the lathe and cut both threads. Screw tight into run of tee. Centre again and turn the bearing to a nice running fit in the sleeve.

3. *Polar axis.* Run on the locknut. Screw the pipe tight into outlet of tee. Back the locknut tight against tee. Centre in lathe. When in centres but before the polar axis journals are turned the squareness of the machined declination axis should be checked by the chuck or face plate. If slightly out of square the polar axis can be bent to correct this. When checked turn the cone on the locknut for the upper journal and the pipe 1⅝-in. diameter for the lower journal.

DESIGN B

1. *Declination sleeve.* Proceed as for design A.

2. *Declination axis.* Mount on cone centres in the lathe and turn the bearing for declination sleeve.

3. *Tee.* Ream the run to 1 11/16-in. diameter. Drill and tap the run bands for four 3/16-in. flat ended centering screws in each. See Fig. 3*B*.

4. *Polar axis.* Run on the locknut. Screw the pipe tight into outlet of tee. Back the locknut tight against tee. Centre in lathe and turn the cone on the locknut for the upper journal and the pipe 1⅝-in. diameter for the lower journal.

5. Pass declination axis through run of tee to correct position lengthways. Adjust the centering screws until it is square with the polar axis. When proved correct, paint the sleeve bearing to prevent rusting and pack full the space surrounding the declination axis within the tee with neat portland cement, mixed fresh with water to

a stiffish paste. Keep moist for four or five days to assist the permanent setting of the cement.

Squareness of the two axes can be proved in two ways:

1. *Without the telescope.* The method assumes that the ends of the pipe have been freed of cutting burrs and that the wall thickness does not vary throughout its length. In each end of the declination axis fix a tin or cardboard disc having a small hole drilled centrally in it. Then the line through the centres of these holes is parallel to the centre line of the declination axis. Tighten the centering screws, Fig. 3*B*, sufficiently to prevent the declination axis from moving in the tee. Set the box carrying the polar axis in its bearings securely in a vertical position, see Fig. 3*C*. Through the holes in the two discs sight on a distant vertical line. Reverse the declination axis by rotating the polar axis through 180° and again sight on the line. If as is probable the lines of sight do not coincide, the axes are not at right angles. Mark the line halfway between the points where the lines of sight strike it and by means of the pairs of centering screws *A*, *A*, Fig. 3*B*, adjust the position of the declination axis in the tee until one line of sight strikes this middle point. Reverse the declination axis and resight. When the sights in the two positions coincide the axes are at right angles.[3]

2. *By observations with the telescope on circumpolar stars.*

The telescope saddle is frequently the weakest and least satisfactory part of an amateur mounting. Without being clumsy it must be stiff enough not to sag or bend and throw the telescope out of line. In this mounting the saddle is made of well seasoned oak or other hard wood ¾-in. nett thick.[4] As it is greatly weakened by the hole cut to clear the end of the declination sleeve it is stiffened by a plate of No. 14 iron, *K*, on which, instead of on separate washers, the nuts of the saddle bolts bear.

II

The essential parts of the mounting are now completed. Much

[3]A beam of light through the two holes can be used instead of sighting. If used to check the work in design A, remove the counterbalance arm and test only the short arm of the declination axis.

[4]If of soft wood the thickness should be increased to 1-in. or 1¼-in. nett.

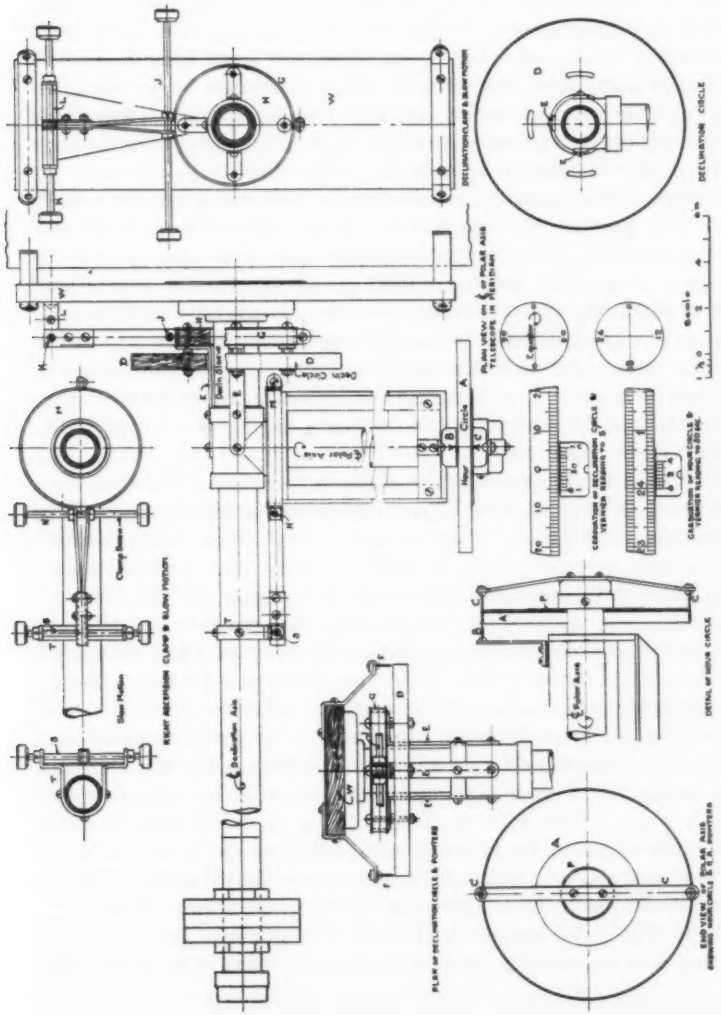

Fig. 4.—Details of Circles, Clamps, and Slow Motions, Young Mounting.

can be done with a telescope having a no more elaborate mounting. But to be usable to the full extent of its powers a telescope must be adequately equipped for its work. The bare bones must be clothed. Certain accessories other than the usual finder must be provided. As this article is written for the beginner wrestling with the intricacies of building a telescope and anxious to achieve the utmost from his great adventure, it appears appropriate, while describing how they are applied to this mounting, to discuss why these accessories are needed.

It is true that the mounting can be used without these accessories —even permanently—but many patient hours have been spent by its maker in carefully shaping, polishing and figuring the mirror until it is practically perfect: he has provided his telescope with as good eyepieces as he can afford: I would urge him to be patient for a few hours more and to make a complete and thorough job of the mounting while he is about it, with the assurance that he will be far more than merely repaid in the satisfaction of using an instrument that fulfills all demands upon it.

The first glance at Fig. 4 may suggest that fitted with these accessories, the mounting is far from being the simple affair of the previous illustrations. When the several items are examined separately, however, it will be realized that the apparent complication is due to the unavoidably small scale of the figure and that individually they are quite simple.[5] First then, for directing the telescope to the desired object there should be provided hour and declination circles. The objection that circles are useless on a portable telescope because they require that it be accurately levelled and oriented has but little weight even when the instrument is set up temporarily in a casual position and none when in its usual place, while the advantage of being able to direct it to an object invisible to the unaided eye is very great. Even in a casual position it is not difficult in a few minutes to orient the telescope with sufficient exactness for circles to be used and by making the simple preparations described below it can always be set up accurately at the home site without delay.

In Fig. 4 the hour circle *A*, is of Airy's design. Airy's circle is convenient as it enables the hour angle of an object to be set off with-

[5]Detailed construction drawings of this mounting may be obtained from the author.

out calculation. The circle is free to turn on the polar axis and in this instance is prevented from tilting by bearing against a disc *P* of No. 14 iron soldered to the cap on the end of the axis. Three pointers are required: a stationary pointer *B*, for indicating sidereal time, secured to the mounting and two (so that one shall always be easily seen) *C, C,* for indicating right ascension, secured to the polar axis.

To use it, the circle is first rotated on the polar axis until the right ascension of the object sought is at an R. A. pointer; then the polar axis and the hour circle are rotated as a unit, carrying the telescope round with them, until the sidereal time at the moment is seen on the circle at the sidereal time pointer.

The declination circle *D* is carried on three strap iron brackets *E* secured to the tee connecting the polar and declination axes. The screw holes in the disc of the circle are slotted for adjustment of its zero. Two pointers *F, F* are fitted.

The circles shown are graduated on the basis of 12 divisions per inch, to 4 minutes of time and 1° of arc respectively. If desired Vernier pointers can be fitted which permit of reading the hour circle to 30 sec. and the declination circle to 5′. Details of these are given in the figure. The hour circle is intended to be read from a position to the south of it.

A simple way to make the circles is to mark out the graduations by etching or scribing them on a flat strip of brass, or even drawing them with india ink on hard surfaced paper and joining the ends. The disc of the circle which may be of wood or brass is then cut a shade large and filed until it fits the inside of the ring so formed. The graduated ring is then fastened to the disc with small pins, solder or glue as suitable. For the sake of illustration the disc of the declination circle is shown in the figure as of wood and as of brass for the hour circle.

All wood work, and paper scales if used, must have at least three coats of waterproof clear varnish to protect them from dampness.

Next there is needed a declination clamp to maintain the setting of the telescope in declination when this has been done; for once set it will not require changing except perhaps through a few minutes of arc, as for example when using a high power on the moon. If not clamped, any movement in right ascension may, and probably will,

so disturb the setting in declination as to throw the object out of the field of view causing a vexatious loss of time especially when guests are present.

Fourth, for ease in making the setting accurately, a slow motion in declination should be fitted. Referring to Fig. 4, *G* is the clamp, of strap iron, enclosing the hardwood clamp drum *H*. *J* is the clamping screw of ¼-in. cold rolled iron.[6] The tangent screw *K*, for the declination slow motion is carried in strap iron bearings *L* screwed to the back of the telescope saddle *W*.

Fifth, there is needed some means of controlling the motion of the telescope in right ascension. It is held by some that a drive of any sort is not a necessity for a small telescope. While this may be true, broadly speaking, it is none-the-less true that for a stationary telescope, even if small, a drive is of great convenience, especially when using high powers and when the use of both hands is required in sketching or other note-making, while at the eyepiece when an automatic drive is very desirable even if as elementary as that recently described in this JOURNAL.[7] But although such a drive can be adapted without difficulty to this mounting, that course is not recommended unless the stand and the mounting can be removed as a unit, or, better, remain set up undisturbed when the telescope is taken indoors. For the portable telescope that must be set up and taken down piece by piece at the beginning and end of each observing period, the simple tangent screw and clamp shown in Fig. 4 is preferable. Here, *M* is the right ascension clamp drum, secured to the upper bearing plate of the polar axis and *N* the clamping screw. The tangent screw *S* is carried in strap iron bearings *T* fastened to the counter balance arm of the declination axis within easy reach while observing. The tangent screw shown is long enough to enable an object to be followed for over an hour without resetting.

Lastly there is the problem of illuminating the circles so that they can be read. A great improvement over the usual hand flash light is a flash light bulb mounted on a head band or cap as is a miner's lamp. The light is out of one's eyes and is ready when wanted in

[6]Clamp screws should be tightened only enough to prevent slipping.

[7]"Two simple drives for small telescopes," this JOURNAL, vol. 33, p. 5, 1939. See also the notes on drives, this JOURNAL, vol. 31, 1937, p. 17.

examining maps, making notes, etc., and both hands are free. Wires are run to the lampholder from the battery in the flash light tube which is carried in some convenient pocket. The lamp holder and reflector from an ordinary flash light can be adapted easily to this use, a wooden plug being inserted in the tube to hold the battery cells in place. A No. 6 or 8 machine screw through the plug forms the central contact and the terminal for the positive lead to the lampholder, the other lead being connected similarly to the negative end of the flash light tube. The connections made should utilize the original switch. Details depend upon the construction of the particular flash light used.

Fig. 5.—Plumb-bob Levelling Device.

As was suggested above, by making certain preparations at the home site, setting up the telescope correctly there becomes a simple matter when once it and its accessories have been put into correct adjustment. These adjustments are correct when, (the stand being in position and level), 1, the polar axis is parallel to the earth's axis

and 2, the declination pointers read 0° and the right ascension pointers read respectively the same, and the same ± 12 hr., as the sidereal time pointer when the telescope is directed to the intersection of the meridian and the celestial equator. For detailed instructions for making these adjustments reference must be made to text books on practical astronomy.[8] The preparations needed are: 1. Providing the telescope stand with a level indicating device. 2. Providing permanent sockets at the site into which the levelling screws in the feet of the stand shall fit.

1. The level indicator is shown in Fig. 5.

This type is preferred to the commonly used circular level as being more accurate. A small iron angle *A* with a fine hole drilled in it is secured to the north face of the post near its top, two similar angles *B, B,* are fastened as far below it as will allow a plumbob to swing clear beneath them. A piece of thin brass *C* with a 1/16-in. hole drilled in it is secured to the brackets *B, B,* by No. 8 machine screws. The screw holes in the angles *B, B* are slotted in a north south and those in *C* in an east west direction. The fine braided cord of the plumbbob which may be a 1-lb. lead ball, is passed up through the holes in *C* and *A* and made fast so that the bob may swing clear. When the stand is made accurately level, the third piece *C* is adjusted on No. 2 until the cord swings centrally in the 1/16-in. hole. The screws are then tightened permanently. Thereafter, when setting up the telescope, the levelling screws are adjusted until the cord again swings evenly across the centre of the 1/16-in. hole. The stand is then level.

2. First, a true (not compass) north and south (meridian) line is laid off at the site by setting two fine plumb lines suspended some 8 to 10 feet apart and a low southern or northern star all in line at the moment when the star crosses the meridian.[9] If the sidereal time is known within half a minute or so, the final line will be sufficiently accurate for the purpose in hand if it is the average of the positions found by observations on three or four stars.

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[8]Campbell's "Elements of Practical Astronomy," The Macmillan Co., London, is excellent. Instructions were also given in the articles on telescope mountings previously cited. See particularly this JOURNAL, vol. 31, 1937, p. 156 *et seq.*

[9]Let the bobs swing in water to steady them.

Second. With the meridian line as a guide, lay off the positions for three posts so spaced that when the telescope is correctly oriented the points of the levelling screws on the stand shall rest centrally on them. When driven firmly into the ground, the tops of the posts, which may be 4 × 4-in. and tarred for durability, are cut off level with one another and conveniently close to the ground.

Third. Plates of No. 14 brass or sheet iron about 3-in. square are screwed to the tops of the posts. The plate on the north post, *N*, Fig. 6, has a 5/16-in. hole drilled in its centre, the others being left plain for the present.

Fourth. The stand is set up on the plates with the point of the north levelling screw in the hole in plate *N*, and carefully levelled.

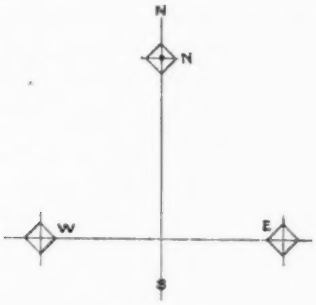

Fig. 6.–Orienting Device.

The other adjustments are then made in their proper order by observations on stars. They are not difficult to make but they must be made carefully. When they are completed the positions of the east and west levelling screws are marked on plates E, W, and 5/16-in. holes drilled for them which completes the preparations. As the screws are always placed in the same holes when setting up the telescope, it will always be correctly oriented.

III

And now that you have fashioned a telescope, what are you going to do with it? Treat it as a toy to be played with for a while and

then forgotten, or as a splendid tool to aid you in learning and in sharing with others something of the glory and mystery of the stars, and to do good work with by helping, as you can, in the never ending quest for facts: facts that will enlarge if ever so slightly our knowledge of this universe: facts needed in the interpretation of the cosmos: that the great observatories perforce neglect because they seek other facts that only they with their great telescopes may perhaps discover. Only in some such way will your great adventure really repay you. Only so indeed can it really begin, when you become one of the great brotherhood of astronomers, professional and amateur, that is searching ceaselessly for more light on the nature of things.

What are you going to do with your telescope? Do not waste it. This Society will aid you to put it to work and the American Association of Variable Star Observers will welcome your help and will furnish you with instructions and maps to equip you fully to cooperate in this most interesting and valuable pursuit. Do not think your work will not be worth while. As Dr. Carvell has said "There is no example of a scientific search for truth which has not been rewarded."

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THE DEDICATION OF THE McDONALD OBSERVATORY

By Helen Sawyer Hogg

ON May fifth of this year occurred one of the most important astronomical events ever to take place on this continent—the dedication of the McDonald Observatory in the mountains of southwestern Texas. It was important in three ways: first, because it marked the culmination of one of the most generous bequests ever made to astronomy; secondly, because a huge telescope of 82-inches aperture marking the height of engineering skill was being declared officially ready for use; and thirdly, because through the generosity of the Warner and Swasey Company there was assembled a supergalaxy of important American astronomers such as has seldom taken place before.

The beginning of the McDonald Observatory was in the year 1926 when the will of William Johnson McDonald, a banker of Paris, Texas, and a lover of astronomy, was read. He left the bulk of his estate to the regents of the University of Texas "to be used and devoted—for the purpose of aiding in erecting and equipping an astronomical observatory to be kept and used in connection with and as a part of the university, for the study and promotion of the study of astronomical science." The bequest amounted to more than a million dollars. An attempt was made to contest the will. Mr. McDonald had once remarked to a Negro barber that some day a telescope would be constructed that would enable an astronomer to see the gold-paved streets of the New Jerusalem; this whimsical remark was used in the attempt to break the will. The litigation caused a shrinkage in the estate so that the final amount received by the University of Texas was about $800,000.

The University of Texas did not consider this sum adequate for building and operating a big observatory and was allowing the fund to accumulate. In 1932 Dr. Struve, in conference with President Hutchins, of Chicago, remarked that the University of Texas might need some help to operate their telescope as much as the University of Chicago needed a big telescope in the south. Within a few minutes President Hutchins got in touch again with Dr. Struve saying that

he had just been talking to President Benedict, of Texas, on the telephone, and thought they could come to some arrangement. The final agreement was that Texas would build and equip the observatory and the two institutions would co-operate in its operation for thirty years, with Chicago bearing three-fourths of the budget and Texas one-fourth.

The observatory is located in the Davis mountains of southwest Texas at an altitude of 6,828 feet, in longitude 104° and latitude 30°N. To a person from the crowded east the country seems entirely deserted. Ranches with sixty or more square miles in each abound in the region. The vegetation is sparse but not desert. The numerous hills and mountains around are covered enough to prevent undesirable atmospheric conditions such as dust storms and bad seeing. Residences for the astronomers and engineers on the staff have been built on the mountain top. Views from the windows of the various homes leave an eastern spectator overcome with the magnificence. The silvery dome on the top of Mount Locke is visible for many miles wherever vistas can be obtained through the hills and mountains which cluster in the region. An unusual feature of the dome is that it houses not merely the giant telescope, but library and offices, and living quarters for several members of the staff.

Not only does the Warner and Swasey Company deserve credit for the construction of a beautiful instrument, but also for their generosity which brought well-known astronomers from all parts of the United States and several points in Europe. It is reliably reported that the Warner and Swasey Company lost a great deal of money (enough to build another smaller telescope, as one astronomer remarked) on the construction of the telescope, and provided an 82-inch instrument when the contract called for only 80 inches. It is certainly a splendid example of scientific goodwill in that they turned the other cheek and paid out ten thousand dollars in travelling expenses to prominent astronomers to speak at a symposium on galactic structure at the dedication of the observatory.

Most of the astronomers from the East, newspaper men and persons prominent in the firm of Warner and Swasey travelled south on two special cars from Chicago. The journey was a pleasant one and the astronomical interchange of thought started long before the party

reached Alpine. On Wednesday each of us was presented with a beautiful book on the observatory; copies of the book circulated round and round in the lounge car for autographs. One of the interesting occurrences of the trip down came at Austin, Texas. President Stil-

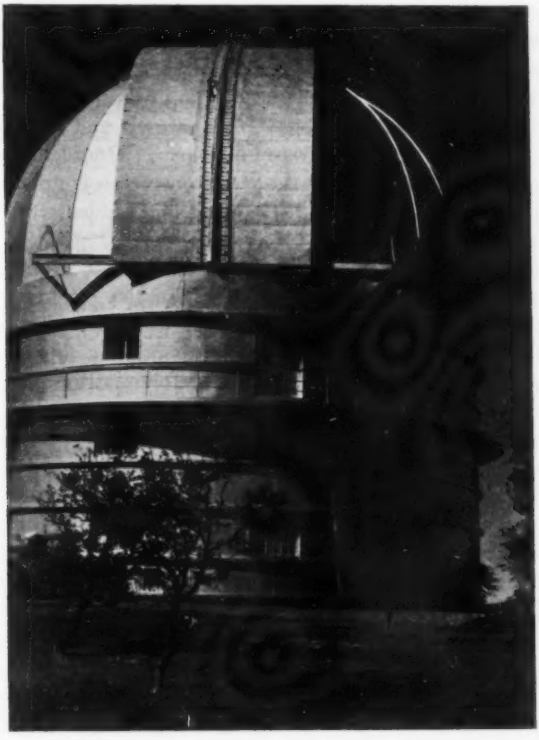

Fig. 1.—The McDonald Observatory of the University of Texas.

well, of the Warner and Swasey Company, Dr. Shapley and Dr. A. H. Compton were scheduled to speak on a radio broadcast from San Antonio. The train was late; the speakers were snatched from the train at Austin and given an escort of motorcycle police and speed-

ing automobiles to the broadcasting station. We listened to the broadcast on the radio in the lounge car as our train was entering San Antonio. A beautiful sight-seeing trip around San Antonio was followed that evening by an exquisite dinner party, which two astronomers independently described as being "of more than Oriental splendour."

It is a pity that some of the people most intimately concerned with the construction of the telescope could not have lived until its dedication. The assembly felt the absence of those who have died during the construction of the telescope: Mr. Swasey and Mr. Burrill, engineer of the Warner and Swasey Company; President Benedict of the University of Texas, who as an astronomer was greatly interested in the development of the telescope; and President Bliss of the Warner and Swasey Company.

The ceremonies opened on Thursday afternoon at Alpine with a joint meeting of the southwestern division of the American Association for the Advancement of Science, at which many interesting astronomical papers were presented. An association dinner in Sul Ross State Teachers' College at Alpine was followed by a lecture by Prof. A. H. Compton.

The party was then taken to its various resting places at the close of the lecture. It was necessary to scatter the guests over quite a wide territory, as the villages are small and the hotels could accommodate only a few people at once. Most guests stayed at least ten miles from the observatory and many as far as forty miles. But the Warner and Swasey Company had made excellent bus arrangements so that we were transported to and from the meetings at the observatory most conveniently. It was carefully pointed out to start with that traffic was not heavy on the surrounding roads; that the buses had to leave on schedule, and that a dilatory astronomer who was so unfortunate as to miss the bus would have the dubious pleasure of hiking anywhere from ten to forty miles. There is no recorded case of an astronomer who missed the bus!

The actual dedication ceremonies took place on Friday, May 5. The observing floor of the dome was filled with chairs and the various speakers stood on the Newtonian platform, while a lantern resting somewhere in the main axis of the telescope projected slides as necessary.

The actual appearance of the 82-inch reflector in its dome is not unlike that of the Victoria and Toronto instruments. An astronomer who has worked with either of the Canadian reflectors would feel at home with the McDonald instrument. The Coudé room is of course a different feature; the Newtonian platform is built in a different manner. The spectrograph is of light, compact construction. Canadians may be proud to feel that they have had a share in the development of the giant telescope since Dr. J. S. Plaskett was the consulting engineer for its construction. Canadian astronomy was represented at the dedication by Dr. and Mrs. J. S. Plaskett, Dr. J. A. Pearce and the writer.

Dr. Shapley, as the opening speaker Friday morning, fluently discussed many of the vital problems which variable stars present—preferred frequency of periods in the Magellanic Clouds, and unusual variables like DF Cygni. Dr. Gallo spoke of Mexican astronomy, in particular of the Carte du Ciel. Dr. Plaskett discussed some features of the telescope which may be of special interest to our Canadian readers. While the mounting of the telescope is similar to that of the Dominion Astrophysical and David Dunlap instruments, it has three different optical combinations, giving a prime focus of 26 feet, a Cassegrain of 91 feet, and a Coudé of 158 feet. The tube is six feet shorter than that of the 72-inch so that the dome has a diameter of 62 feet instead of 66. To an observer used to the Canadian instruments the telescope has a squat and compact appearance. A very stubby declination axis is also a new feature; although only 29 inches long it is designed to carry 16 tons load. The telescope is designed to be used at the prime focus rather than the Newtonian focus. Dr. Plaskett also called attention to the different rates of motion in declination. The ratio of the fastest to the slowest motion is 1,080,000 times and at the slowest it would take 10,000,000 minutes or 19 years for one revolution of the tube.

A chuck wagon dinner was held at noon at the Observatory, where the Warner and Swasey Company supplied some four hundred people with lunch in Mexican style. The Mexican cooks from nearby ranches had started their fires about 3 a.m., and by noon two cows, four sheep and large quantities of other foods were ready for consumption, after being cooked in numerous fires on the ground.

The afternoon ceremonies at the observatory were devoted mostly to formal speeches by persons most intimately connected with the telescope. Dr. Plaskett spoke on the test of the mirror. The 82-inch mirror is of Pyrex glass, figured in the optical shop of the Warner and Swasey Company by Mr. Lundin. The surface of the

Fig. 2.—Two scenes at the doorway of the McDonald Observatory, at the time of the opening ceremonies. At the left are Dr. J. S. Plaskett, astronomical consultant of the Warner and Swasey Company, and Professor Otto Struve, Director of the Observatory. At the right is a group including Professor H. N. Russell of Princeton, Dr. Plaskett, Professors Shapley of Harvard, and Struve, and Dr. J. A. Pearce of Victoria, B.C.

mirror is true to its parabola within one-millionth of an inch. The JOURNAL hopes to publish Dr. Plaskett's full report on the tests of the mirror. In the evening we were given a chance to see the globular

cluster Messier 3 at the Cassegrain focus, and all rejoiced in the beautiful pin point images.

Tributes should here be paid to the ladies of the McDonald Observatory staff, Mrs. Struve, Mrs. Elvey, Mrs. Seyfert and Mrs. Kuiper who undertook by a series of lunches and dinners to entertain as many of the visitors as possible. The guests greatly enjoyed these pleasant interludes and hope that the hostesses were not overtired from the exertions of feeding so many people on a mountain top.

The symposium on galactic and inter-galactic structure continued without break for morning, afternoon and evening, from Saturday morning until Monday noon. It is fortunate that the papers will be published in detail—to mention even their high lights is impossible. Their daytime meetings were held at the observatory; the evening meetings at Indian Lodge, a delightful State Park Hotel about twelve miles from the observatory. The lectures were informal and one was free to ask questions at any point. Some subjects aroused considerable discussion, as, for example, in which direction the spiral nebulae are rotating. Dr. Oort, as the first speaker Saturday, paid the McDonald Observatory a pretty compliment by remarking that the McDonald Observatory had done more before its birth than the Leiden Observatory did in the first hundred years of its existence! He referred particularly to work on light of the night sky, zodiacal light, and white dwarfs. Dr. Trumpler produced most revealing statistics to show why galactic star clusters escape detection at distances greater than a few thousand parsecs (depending on richness of cluster). Dr. Struve discussed problems arising from the discovery of emission lines in nebulae as far as 100 parsecs from the exciting stars. Dr. Bok showed from star counts that the star density drops with increasing distance from sun for distances up to 2000 parsecs. Dr. Elvey talked on galactic light, illumination concentrated near galactic plane after correction has been made for all known sources, probably due to extended reflection nebulosities scattered through Milky Way. Dr. Kuiper's energy made itself felt by his confession that he had taken 600 spectra of 300 stars ranging in apparent magnitude from 8-16 with the McDonald telescope in the past six weeks and found two new white dwarfs and several stars with continuous spectrum. Dr. Milne discussed congruent time-keeping with respect

to extra-galactic nebulae. Dr. Baade discussed the extra-galactic system I.C.*1613* showing excellent Cepheid light curves and a magnitude sequence accurate to magnitude 21.0. Dr. Shapley in summarizing details of the 300,000 nebulae now photographed by the Bruce telescope also called attention to the extension atmosphere of star clusters, variables, etc., surrounding such objects as the Magellanic Clouds and Andromeda nebula which appear to make their diameter much greater than previously supposed. Dr. Payne-Gaposchkin, discussing a precise photometric investigation of the colours of five thousand stars, finds negligible obscuration in high latitudes and varying amount in low latitudes. Dr. Morgan showed striking results of colour determination of B stars by the Tikhoff method. Dr. Lindblad's theories of spiral structure favour the direction of rotation as the one in which spiral arms wind around the centre when followed outward from the nucleus. This is at variance with the ideas of some of the other astronomers concerned with nebulae. Dr. Chandrasekhar discussing star streaming employed an equation with 93 terms; he showed a theoretical reason for an upper limit to the eccentricity of elliptical nebulae. Dr. Hubble showed numerous beautiful slides of extragalactic nebulae, proving in particular a continuous sequence with transition forms from early globular (*E0*) to late spirals *Sc*, and *SBc*, particularly emphasizing the transition stage, but recently noticed, between *E7* and *Sa* and *SBa*. Dr. Stebbins' work on colours of 1300 B stars makes the absolute magnitude of these objects a magnitude brighter than previously assumed, and shows a decided limit to absorption in the direction of the anti-centre. Dr. Russell, discussing a general catalogue of 2500 dynamical parallaxes suggested photographic re-measurement of early double stars measured before 1870.

Dr. Hubble expressed the thanks of the assembly for the best astronomical meeting he had ever attended—one in a class by itself —expressing the hope that the example might become the fashion. He expressed congratulations to the Warner and Swasey Company for the telescope and for their generous contribution to research in sponsoring these meetings; and congratulations to the Director and staff of the observatory for their hospitality and care and judgment in the organization of the programme.

After the end of the scientific meetings Monday noon, we were treated by the Warner and Swasey Company to a rodeo at a nearby ranch. A sign posted in the nearest town, "$5 reward for the wildest bucking broncho for the rodeo", nearly caused some of us to lose courage. But the rodeo was without mishap and was greatly enjoyed by all. Many of us had watched the processes of calf-roping and broncho-busting only on movie screens before.

Time would fail to tell of the amusing non-astronomical incidents which were enjoyed by the assembly: of the walk down the warm south slope of the mountain when astronomers Bok and Oort and newspaper men Blakeslie and Nichols found themselves set upon by a rattlesnake—but emerged as victors with Dr. Oort the proud possessor of the rattle to take back to Leiden; of the prominent astronomer who was so absorbed in the symposium that he came to breakfast without a tie; and of his two lady companions at the breakfast table who were so absorbed in his words of wisdom that they were quite oblivious of the lack of neck gear; of the adage propounded by Henry Norris Russell at the closing session of the symposium, which will make most astronomers think twice before including points of low weight in statistical discussions, "Every housewife knows that you don't improve an omelet by breaking in every egg which is handed to you."

Monday night the astronomers left Fort Davis, heading west. The two private cars from the east were taken to El Paso and on Tuesday the party were taken on a delightful 300-mile bus trip across western Texas and southern New Mexico to see the miraculous Carlsbad caverns. A hike of five miles under ground through the magnificent stalactites, stalagmites, and columns proved to be so stupendous that even the newspaper men accompanying the party ran out of adjectives after the first mile! It was a fitting climax to a week of memorable events.

May 16, 1939,
Steward Observatory,
Tucson, Arizona.

A MAP OF MERCURY IN 1936-1938

By Hugh M. Johnson

IN text-books on astronomy one usually reads that the planet Mercury shows little or nothing in the way of detail on its surface in the telescope. Certainly this is true to a large extent, but the very difficulty of seeing detail sometimes attracts the amateur astronomer interested in planetary work to an object. And in Mercury's case, due to the poor "seeing" almost inevitably incurred in its study, large telescopes have little or no advantage over small instruments, but again we are at some disadvantage because of the smaller capacity for definition optically of the small instruments.

Having in mind these difficulties among others found in the study of Mercury, the map illustrating this article has been prepared from observations in the years 1936, 1937, and 1938, during five eastern and four western elongations. More than fifty drawings made at the telescope by the following observers were used: Walter H. Haas, Alliance, Ohio, 10-inch refractor; Edwin P. Martz, Jr., Jamaica, B.W.I., 12-inch reflector diaphragmed to 5-inches aperture; Wolf W. Spaugenberg, Schwerin, Germany; and the author, Des Moines, Iowa, 7-inch reflector diaphragmed to 5-inches aperture.

It must be understood that large differences in drawings of the same thing occur between various observers due to differences in optical equipment, eyes, atmospherical conditions, and methods of sketching. Therefore, in compiling a map of the especially difficult planet Mercury from drawings by four observers, the author had to base it on his own work and confirm, alter, and extend it by comparison with the other drawings. It should here also be stated that among the observers Haas draws the most complex and unlike detail compared with the others. Martz and the author agree quite well. An article by Haas on Mercury and Venus appeared in the July-August 1937 issue of this Journal.

The map was photographed by Mr. J. Russell Smith, Smyer, Texas. Similarly to other maps of Mercury, this map was based on the assumption of the 88-day rotation period, *i.e.*, that the

planet keeps the same face toward the sun, neglecting libration. This is apparently confirmed independently, and so collectively, by the four observers. This period of rotation has been adopted after being found by each of the following well known planet observers in their maps of Mercury: Schiaparelli (1889), Lowell (1897), Jarry-Desloges (1920), Antoniadi (1929), and the Mercury and Venus Section of the B.A.A. (1929 and 1934). An excellent discussion of these maps and of Mercury in general may be found in the October 1936 issue of the *Journal* of the British Astronomical Association in an article by the Director of the Mercury and Venus Section, Henry McEwen.

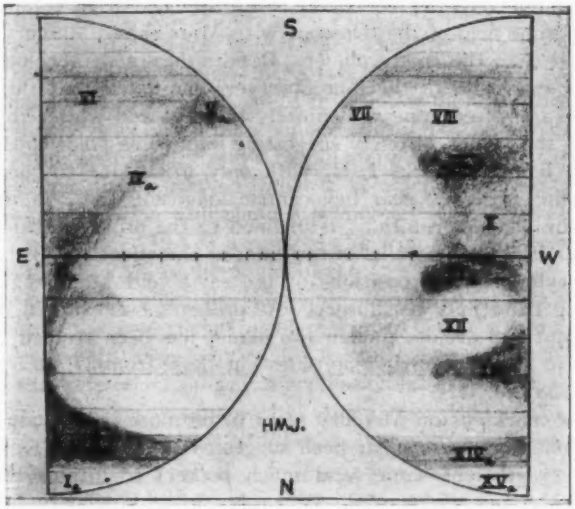

Fig. 1.—A map of Mercury, 1936-1938.

On the present map the mean "equator" is the line intersecting the tangency of the arcs at which point is the assumed subsolar point, the region under the perpendicular rays of the sun. Since the planet is near conjunction with the sun when this region is presented toward the earth, we are not as certain of the detail

there as we are of the terminator marks, and no pretense of complete detail in the maps for it is made. Among the other more certain marks noted with Roman numerals those denoted by *a* are the most certain. The following nomenclature as originated and extended by Schiaparelli and Antoniadi can be applied: I_a, *Borea, Caduceata;* II_a, *Dionysi;* III_a, *Lycaonis;* IV_a, *Horarum Vallis;* V_a, *Jovis;* VI, *Solitudo Hermae, Trismegisti, S. Martis;* VII, *S. Maiae;* VIII, *Cyllene;* IX_a, *Atlantis;* X, *Pieria;* XI_a, *S. Criophori;* XII, *Pentas;* $XIII_a$, *S. Aphrodites* (?); XIV_a, *S. Aphrodites* (?); XV_a, *Apollonia.* In spite of this identification much uncertainty exists.

In colour Mercury appears in a darkened sky to be red or orange, but in a blue daylight sky is very pale gray. Telescopic comparisons in the same field of the telescope with Mars shows Mercury much less red than the ruddy planet. Besides these general colours, the author especially of the four observers has noted that the north "cusp-cap" often appears definitely brighter and whiter than the rest of the planet, strongly suggesting impossible polar caps! The author has seen marks I_a-II_a with only 67x. Due to curving of the band II_a-XIV_a near heliocentric longitude 130°, it may be that the "axis of rotation" is inclined to the orbit, in which case the band is not a parallel of latitude; or the effect may be caused by varying relative positions of the earth and Mercury; or the curving band may be illusory. At present observational data is too scanty to decide, though the planet has been studied by the group in all heliocentric longitudes but those from 37° to 56°, and from 258° to 311°.

The markings on Mercury seem to be more conspicuous than those on Mars, and it has been suggested that if Mars were seen under exactly the same (and much poorer) conditions that we study Mercury there would be a very great similarity between them.

Much remains to be done on the Elusive Planet!

3207 Cornell Street,
Des Moines, Iowa.

REMOVING THE GLARE

By H. A. MacTaggart

When one thinks of "glare" one usually has in mind that distracting excess of light from surfaces—the glass of windows, the covers of meter instruments, the glazed pages of a book, etc., which makes observation more or less troublesome. The removal of "glare" in such cases would certainly add to the comfort of mankind.

There is, however, another field—that of optical instruments—in which the loss of light by reflection is very undesirable. To astronomers anxious to make the most of the faint light from a distant star or nebula the loss due to reflection at the surfaces of the lenses in their telescopes, the loss at the surfaces of the prisms in the spectrograph, etc., is a distinct loss indeed. Mr. Dennis Taylor has pointed out an unexpected fact—viz.—that a tarnished lens surface transmits more light than a polished one. In addition he succeeded by a chemical process in producing a suitable tarnish. The problem then seems worth considering from a research point of view. If this loss could be removed the method would be of practical interest to many people—in connection with photographic objectives, telescopes, range finders, periscopes, etc. In a periscope for example with many parts the loss may be 75% of the original light.

Recently this problem has been approached from another angle by the study of the properties of mono-molecular films made in a special way. Such films have been studied for their own sake and without any special reference to practical application. Langmuir the pioneer in the United States was followed by Adam in England and by several others. Their efforts have added a great deal to our knowledge of such films.

It is of interest to note how mono-films are made. A large rectangular shallow tray one ft. wide and three ft. long is filled with a very dilute solution of Barium Chloride in water and the surface swept quite clean by movable barriers sliding over the surface. A dilute solution of stearic acid,—a long-chain organic compound,—in benzene is made and a few drops of it placed on the clean water surface in the tray. It spreads over the whole area and when the benzene which is volatile evaporates individual molecules of stearic acid are

left floating on the surface with the acid end of the chain in the water. The acid molecules become attached to the barium molecules in solution forming individual Barium Stearate molecules floating on the surface. If these long chain "soap" molecules are now crowded together by suitable barriers they form a mono-molecular film of Barium Stearate the molecules standing side by side on end in the water surface. The properties of such films—both chemical and physical—are interesting and an account of them may be found in Adam's Book on the "Physics and Chemistry of Surfaces."

It has been found recently that such films may be transferred to a glass plate merely by dipping the plate vertically into the water supporting the film. The technique for doing this has been developed by Miss K. Blodgett working in the General Electric Laboratory at Schenectaday and is described in papers in the Physical Review. As the plate is withdrawn slowly from the water the film attaches itself to the plate with the Barium end of the molecule attached to the plate. If now it is dipped again as it slowly descends another film attaches itself but with the molecules inverted. As the plate is withdrawn another layer is attached and so on. Monolayers to the number of several hundreds may then be built up on the plate forming films of any desired small thickness. These films if built on glass of suitable index show in white light Newton's colours which vary in vividness and attractiveness with the film thickness. The films have a refractive index of 1.48 or thereabouts for Na-light, λ 5893A.

Now a rather surprising change may be made in these films in the following way. If the original mono-layer formed on the water support finds too little barium in the water some of the molecules will be left without barium partners. When transferred to a glass support and built up as described into a film of many layers a proportion of the molecules will be pure stearic acid molecules interspersed amongst the "soap" molecules. If this film is dipped into benzene the acid molecules are dissolved out leaving a sort of open structure with the same thickness but of less density. The result is a film of lower refractive index and a colour different from the original film. This peculiar behaviour has been used by Miss Blodgett to reduce the reflection of light from glass surfaces and in the following way.

When a study is made of the reflection of light from surface films

it is found that if the reflection co-efficient of the air-film surface and that of the film-glass interface can be made the same and if the path difference introduced by the film is an odd number of half-wave lengths then the reflected light will be practically suppressed.

For normal incidence—the two co-efficients are given by Fresnel viz.:

$$\frac{n_o - n_1}{n_o + n_1} \text{ and } \frac{n_1 - n_g}{n_1 + n_g}$$

where n_o is the index of air, n_1 of the film and n_g of the glass. If these are to be equal it follows that $n_1^2 = n_o \times n_g$. As a particular example we see that for $n_o = 1$ as in the case of air and $n_g = 1.52$ for crown glass the value of n_1 is 1.233.

Thus if a film of the right thickness on glass can be made with an index 1.233 we may expect no light to be reflected at normal incidence. The density and with it the index of the film may be controlled in the way indicated above, and when a test is made for the wave-length in question—say sodium light—no light is reflected as predicted. It is found further that when such a film is made of suitable characteristics for normal incidence and a chosen wave-length that the percentage of light of other colours reflected is small and at other angles the glare is not visibly perceptible.

Such a film thus reduces the glare to almost nothing. But unfortunately the film is very easily rubbed off the glass and no way has been found of making it hard so that it may be cleaned from time to time. It does not therefore appear possible to make any general use of it in its present form.

However the idea is being examined in other ways. For example it has been found that by depositing certain materials on glass by evaporation at low pressures, films of the desired index may be obtained very approximately. Substances tried in this way are Calcium Fluoride, Sodium Fluoride and Lithium Fluoride. These make more rugged films but they are not suitable for general use as yet. The second, for example, is affected by moisture.

It is obviously desirable that a solution of the problem should be found and the search which has already attracted some attention is being continued.

A few references are given here for any reader who may wish to examine the question more in detail.

(1) Taylor, H. Dennis—The adjustment and Testing of Telescope Objectives.
(2) Strong, J.—*Journal of the Optical Society of America*, 26, 73, 1936.
(3) Blodgett, Katharine B.—*The Physical Review*, Feb. 15, 1939, p. 39.

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METEOR NEWS

Observations relating to meteors and meteorites are cordially invited.

Leonid Observations, Ottawa, 1938

by

M. M. Thomson and Miriam S. Burland

The Leonids in November, 1938, provided a real thrill for the few Ottawa observers who sat through the two nights of the schedule. These two nights, November 11-12 (Fri.) and November 15-16 (Tues.) happened to be the only two clear nights near maximum. They reminded one of the story of the two people, the one who said he would do a job but didn't, and the one who made no promise, but finally did do his job. Friday night promised to be a good one, but a record of only ten meteors in a total of nearly three hours, with four people on the watch, was anything but conducive to enthusiasm. The next scheduled night, Tuesday, was looked on with grave doubts because the dull weather which had prevailed over the week end and persisted almost to the commencement of observing. Then skies cleared, and at times the small group of observers could not keep pace with the flashing meteors. The average of those recorded was almost one a minute, while the number that escaped recording, due to coming in groups, can only be guessed. Then, too, one of the observers had to jump up at regular intervals to change the three cameras. Enthusiasm ran high, keeping the group to their posts for five and a half hours. For the first time in its short history of observing, the Ottawa group saw a meteor trail endure for four minutes, saw trails of unusual brightness, and saw several that were distinctly coloured. The visual results are summarized in Table I.

The five who had a part in the observing on Friday night were Misses Lena Ellichuk and Miriam S. Burland, and Messrs. Stanley Mott, Sam Palef, and M. M. Thomson. Only four of these people were free on Tuesday night. The three cameras used belonged to Mr. John Cole, Mr. F. W. Matley, and M. M. Thomson, while the film used was supplied through the courtesy of Mr. R. Meldrum Stewart, Dominion Astronomer.

TABLE I.—VISUAL LEONID OBSERVATIONS, OTTAWA, 1938

Date	E.S.T.	No. of Observers	Meteors	
			Leonids	Non-Leonids
Nov. 11-12	1.50 - 4.40	4	3	7
Nov. 15-16	0.30 - 0.50	3	3	10
	0.50 - 1.10		5	9
	1.10 - 1.30		9	3
	1.30 - 1.50		7	6
	1.50 - 2.10		3	7
	2.10 - 2.30		8	7
	2.30 - 2.50		11	2
	2.50 - 3.10		5	3
	3.10 - 3.30		9	3
	3.30 - 3.50		15	3
	3.50 - 4.10		11	6
	4.10 - 4.30		20	5
	4.30 - 4.50		12	6
	4.50 - 5.10		24	9
	5.10 - 5.30		22	8
	5.30 - 5.50		41	6
	5.50 - 5.59		13	0
		Totals.....	221	100

MAGNITUDE DISTRIBUTION

Mag.	−4	−3	−2	−1	0	1	2	3	4	5	Totals	Mean Mag.
Leonids.....	1	5	16	36	42	40	31	27	15	2	215	0.77
Non-Leonids		2	5	1	13	15	21	24	15	2	98	1.86

Three distinct trails were recorded photographically, one of which was seen visually, while the other two were missed. This unfortunately meant that only one could be determined accurately against its background of stars, the other two being assumed to have streaked into view when the camera shutter first opened. These positions were reduced by the writers and will be found in Table II.

TABLE II.—ELEMENTS OF THE METEORS PHOTOGRAPHED NOV. 15-16, 1938, DOMINION OBSERVATORY, OTTAWA

No.	E.S.T.	Trail	R.A.	Dec.	Azimuth	Altitude	Reduction
1.	$1^h\ 39^m$ (start of exp.)	from	$8^h\ 30.1^m$	$-\ 7°\ 59'.6$	$52°\ 59'.7$	$21°\ 02'$	M.M.T.
		to	8 24	−10 20 .3	50 27 .3	19 48	
2.	$3^h\ 12^m$ (start of exp.)	from	6 20	−24 09 .6	6 48	20 09	M.M.T.
		to	6 04	−25 45	11 21	18 02	
3.	$3^h\ 39^m\ 29^s$ (visual mag. −4)	burst from	9 54	+35 30	265 36	58 45	M.S.B.
		to	9 53	+36 16	266 47	59 13	
		beginning of trail at		+32 15			

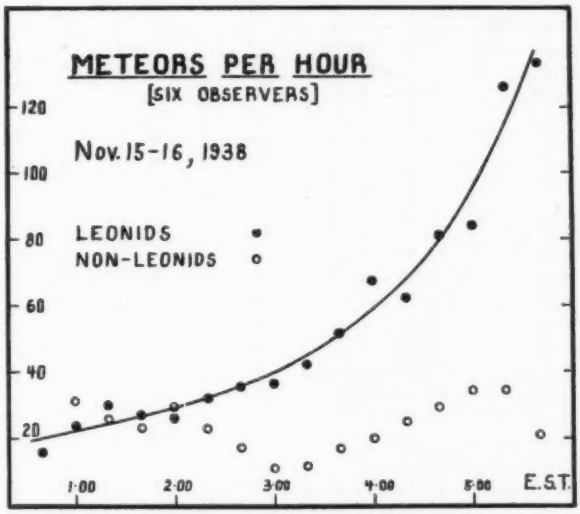


Figure 1.—Visual observation of the Leonid meteors made in Ottawa. Rates have been reduced to six observers by standard factors. Each dot represents the rate for the full 60 minutes centred at the corresponding positions.

The photographic programme included a total exposure time of 15 hours, 24 minutes on three cameras, two of F/4.5, one of F/3.5. The one trail seen visually as well was a Leonid blue in colour with an estimated magnitude of −4.

Dominion Observatory,
Ottawa, Ontario.

SOUTH AFRICAN METEOR OBSERVATIONS, DEC. 1938–APR. 1939

We have another fine series of observations from Mr. Druker, one of our members living in Doornfontein, Johannesburg. The

TABLE I.—METEOR OBSERVATIONS IN THE TRANSVAAL

Date	S. Afr. S.T.	Total Minutes Observed	Weather Factor	Meteors Observed	Hourly Rate
Dec. 18-19, 1938	8.45 - 9.00	15	8	3	12
Jan. 15-16, 1939	7.36 - 8.10	31	8	3	6
17-18	12.17 - 12.47	30	10	4	8
Mar. 17-18	8.05 - 8.37	32	10	8	15
17-18	9.00 - 9.30	30	10	4	8
19-20	8.15 - 8.45	30	8	7	14
21-22	8.45 - 9.15	30	9	5	10
25-26	10.25 - 11.10	45	9	8	11
Apr. 5- 6	9.20 - 9.50	30	4	3	6
7- 8	10.40 - 11.10	30	4	3	6
8- 9	10.00 - 10.30	30	6	6	12
9-10	8.20 - 8.50	30	7	12	24
9-10	8.20 - 8.50	30	7	8*	16
10-11	8.45 - 9.15	30	9	8	16
15-16	8.45 - 9.21	36	8	5	8
16-17	10.31 - 11.02	31	8	6	12
17-18	10.35 - 11.05	30	8	2	4
21-22	11.00 - 11.30	30	9	5	10
22-23	9.30 - 10.00	30	6-7	6	12
23-24	8.55 - 9.25	30	8	3	6
23-24	10.05 - 10.35	30	8	4	8
24-25	11.50 - 12.35	45	10	6	8
Totals...		685		119	

*Observer—M. Matz.

results of these observations are summarized in the tables. The hourly rates in the last column are for one observer and are uncorrected for weather factor. Mr. M. Matz assisted in the observing for one night. In a total of 685 minutes observing time, 119 meteors

TABLE II.—MAGNITUDE DISTRIBUTION

−3	−2	−1	0	1	2	3	4	5	Total	Mean Mag.
1	1	4	5	2	8	26	47	25	119	3·4

TABLE III.—COLOUR DISTRIBUTION

r	rw	o	y	yw	w	gy	g	bw
18	1	17	36	2	33	8	3	1

were recorded, an average uncorrected rate of just over 10 meteors per hour. A higher percentage of yellow meteors relative to red was recorded in these observations as compared with those previously made by Mr. Druker.

P. M. M.

REVIEW OF PUBLICATIONS

Sundials, by R. Newton Mayall and Margaret L. Mayall. 197+ xv pages, 5½ x 8 ins. Hale, Cushman and Flint, Boston, Mass., 1938. Price $2.00

Readers of the Scientific American will remember that some years ago these two authors published a series of articles on Sundials. This series has now been rewritten, expanded and unified, and appears as a pleasing book on Sundials—how to know, use and make them. Mr. Mayall is a noted landscape architect of many talents and interests; Mrs. Mayall has for years been a research astronomer at the Harvard Observatory. Thus a happy collaboration has produced a book which, as well as enjoying the necessary scientific authority, stresses the artistic and architectural importance of the problems associated with the creation and installation of dials of various types.

The development of the sundial from ancient times to the present is traced in the first chapter, while a later chapter describes a number of historical and otherwise interesting dials from all parts of the world. The principles of dialling, the graphical laying out of simple horizontal dials and of dials for various declinations and reclinations, and the actual construction problems encountered are elucidated. One chapter deals with portable dials, while an appendix gives the necessary formulae and examples for the trigonometrical computation of dials, in contrast to the graphical construction described earlier.

As well as many diagrams in the text, there are over fifty half-tone photographs of dials, ranging from a miniature (but actual) dial mounted on a man's finger ring to the largest sundial in the world, the dial at Jaipur, India; and from the first extant American dial (made in England, in 1630, for use in Salem, Mass.) to the great dial of the 1939 World's Fair in New York. This collection of photographs will be of great interest and help to anyone buying or building a dial.

The authors regret the lack of interest in sundial construction during the past half century, but call attention to the recent trend towards dialling as a hobby and as an architectural expression. This book will no doubt accelerate this trend, as it so carefully explains the prin-

ciples of the simplest dials, and yet opens up the field for the construction of the most elaborate improvements and adaptations.

F. S. H.

Tables of Addition and Subtraction Logarithms, with Six Decimals, by B. Cohn. Second Edition, with preface by L. J. Comrie. viii+63 pages, 6 x 9½ins. London, Scientific Computing Service Limited, 1939. Price 10 shillings.

Dr. Cohn's very useful table of addition and subtraction logarithms has been out of print for some time. While the rapid increase in the use of calculating machines has greatly decreased the use of such logarithmic tables, yet for field work the demand has been sufficient to call for a new edition. This new edition is sponsored by the Scientific Computing Service, of which Dr. Comrie is director. It is clearly copied by the photo-lithographic process, on good paper, well bound, and of a convenient size.

F. S. H.

Astronomy for the Benefit of Mankind, by J. D. Johnstone; vol. 1. Pp. 114, 5 x 7 ins. The Orcadian Book Co., 106 Horseferry Rd., London, S.W.1, 1939. Price 5*s*.

This is announced by the author as the first of a series of volumes in which he intends to give a popular review of astronomy, laying particular emphasis upon the history of the science. The present volume is a rather disconnected, but readable, collection of poetry, mythology, and elementary facts about some of the stars and planets, with rather more emphasis on the poetry and mythology than on the astronomy. It seems a pity that the author, with the laudable intent of interesting the public in astronomy from a cultural standpoint, did not take more pains to insure accuracy in his work. The only two astronomical diagrams included are from a book published in 1866. This is excusable, even though one places the earth at perihelion on December 31. What is less excusable, however, is that most of the astronomical facts seem to have been taken from a work of the same period which naturally results in the inclusion of many small, but relatively unimportant, errors, and of some very gross ones. In a discussion of the planets of the solar system the problem of the possible existence of Vulcan is described as not yet settled while Pluto is

disregarded entirely and not even listed. One is given the impression that Mercury is visible in the evening throughout March and April every year and at the end of the book it is specifically stated that Mercury will be visible in the west during these months in 1939. Actually Mercury is in conjunction with the sun on April 3, 1939, and from then on is in the morning sky, reaching greatest western elongation May 1. It will serve no purpose to elaborate further on similar points. The astronomical information contained, though approximately correct in most cases, cannot be relied on. Some doubt must also be cast on the accuracy of the part dealing with mythology and ancient history. The reviewer is no expert on either subject but it seems wrong to identify Cupid with Mercury or Hermes and to place the Hanging Gardens of Babylon in the third or fourth millenium B.C. With standard texts on astronomy and modern encyclopedias so readily available the reader has a right to expect accuracy, even in works of the most popular style.

P. M. M.

Our Starland, by C. C. Wylie. Pp. 378, 5½ x 7½ inches. The Ryerson Press, Toronto, 1938. Price $1.25

It is some time since a book on astronomy, written expressly for children, has appeared, and "Our Starland" fills this definite gap in astronomical literature, leaving little to be desired. Written by a competent professional astronomer it is up-to-date, accurate, and well illustrated. The language used is straightforward and simple, well-suited to boys and girls between the ages of 8 and 12. In spite of this, however, a surprising amount of interesting information is included. The allusions to mythology and history, and to the contact of astronomy with everyday life, are particularly apt. Footnotes explain the meanings of difficult terms and a section at the end, enttiled "My Dictionary", gives the pronunciation and meaning of many other words used in the text. The last chapter contains a set of simplified star maps and an appendix includes a calendar of the chief astronomical events for 1939 to 1942 inclusive.

There is little to criticize in this work. It is doubtful if the discovery of Pluto should be described as a parallel case to the discovery of Neptune when the weight of astronomical opinion seems to oppose

this view. It also seems a pity that, with observational astronomy in the United States so wide-spread, the illustrations of observatories and instruments should have been restricted to seven photographs from the Naval Observatory in Washington and one drawing of the 200-inch. The excellent section on meteors and meteorites would be more valuable if a simple description of the distinguishing characteristics of a meteorite had been included.

The above are minor points, however, and the fact remains that "Our Starland" can be heartily recommended to any teacher or parent who wishes to foster an interest in astronomy among the younger generation. The book is attractively bound and reasonably priced.

P. M. M.

NOTES AND QUERIES

Communications are invited, especially from amateurs. The Editor will try to secure answers to queries.

A New Italian Research Observatory

The daily press has for some months carried fragmentary accounts of the gift of a new observatory for Rome. The March-April number of *Die Himmelswelt* contains the first detailed scientific information we have seen about this observatory.

The scientific equipment is being presented to Premier Mussolini of Italy by Chancellor Hitler of Germany, in appreciation of the great Italian discoverer and scholar, Galileo Galilei, and as a token of admiration and friendship. The observatory is to be situated within 15 or 20 miles of the centre of Rome, in a suitable astronomical location, and is to contain auxiliary apparatus, offices, library, machine shop and general research facilities. Living accommodation for the astronomers and students is also to be provided. A suitable location has now been selected on Mount Albano (elevation 1,500 ft.), near the town of Frascati, about twelve miles from Rome and readily accessible from the city.

The chief telescopes, constructed by Carl Zeiss, include a 26-inch refractor in a 50-foot dome with rising floor, for visual and photographic work; an astrographic telescope, with one visual and two 16-inch photographic telescopes; and a 49-inch reflector. The latter is to be of a new design, corrected for a large field, and of great optical efficiency. A new-type transit instrument will be used for accurate time and position work. Auxiliary apparatus will include a registering microphotometer, plate measuring apparatus, a comparator, a one meter objective prism, and an objective grating for the great reflector.

It would appear that this will be the most favourably situated of the large European observatories, and with its carefully planned and well designed equipment, it should take an outstanding place in astronomical research.

Two New Series of Publications

The purpose of *Ricerche Spettroscopiche*, published under the auspices of the Astrophysical Laboratory, of the Vatican Observatory, is to provide a medium for the publication of purely spectro-

scopic researches, which otherwise tend to be scattered through large numbers of different series of publications in physics. Our library has just received the first number of this new journal, which consists of a paper by A. Gatterer and J. Junkes, on the determination, by spectroscopic methods, of the carbon content of certain carbon-steels. Such spectroscopic chemical analyses have application to the determination of the constitution of meteoritic samples.

The *Bulletin Mensuel de la Société Astronomique de Liége*, also received by the Society's library, is an amateur publication, devoted to the popularization of astronomy. This first number contains articles on methods of popularizing astronomy, on the history of stellar photometry, and on the various activities of the Liége astronomers. This monthly publication should prove of special interest to our French-Canadian members.

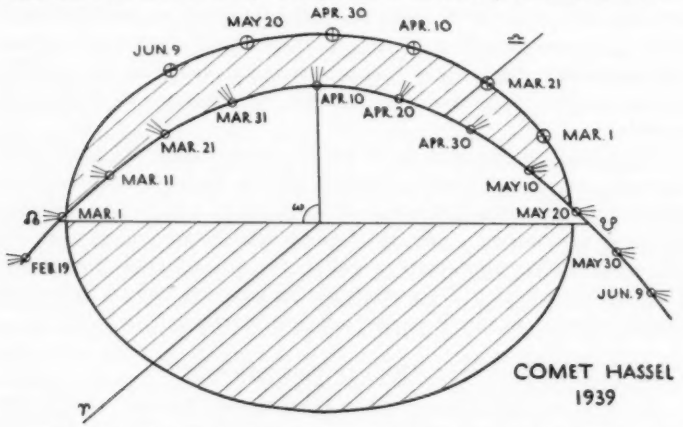
Tree Planting at the Dunlap Observatory

A very satisfactory start has been made the past few weeks towards the creation of the arboretum at the David Dunlap Observatory. The work is being carried on by the staff of Col. LePan, Superintendent of Buildings and Grounds of the University, under the direct supervision of Mr. Shortreed. Nearly two hundred fair-sized trees have been transplanted to the Observatory, and are set out on the hill-top, around the buildings. A more extensive development consists of a nursery at the east end of the property, where many thousand seedlings are being set out, to be transplanted during the coming years to the rest of the grounds. The trees around the observatory include many varieties, chiefly maple, oak, walnut, poplar and spruce, while twenty hardwoods and about a dozen evergreens are represented in the seedlings in the nursery.

Comet 1939d (Hassel)

The announcement of the discovery, on April 16th, of this third magnitude comet was first received from Hassel, and the comet was provisionally known by his name. It has been learned, however, that the comet had been previously discovered by two Russian observers, Achmarof and Jurlof, and also by Mr. Lewis V. Smith, of Segewick, Alberta. The latter observer noted the comet

on the evening of April 15, and wrote of his discovery to Professor Campbell, of the University of Alberta. Mr. Smith is to be highly congratulated on his early independent discovery of this comet.



The orbit of this comet has been determined by Dr. Smiley, of Brown University, and by Dr. Maxwell, of Michigan. Maxwell's elements and ephemeris are as follows:

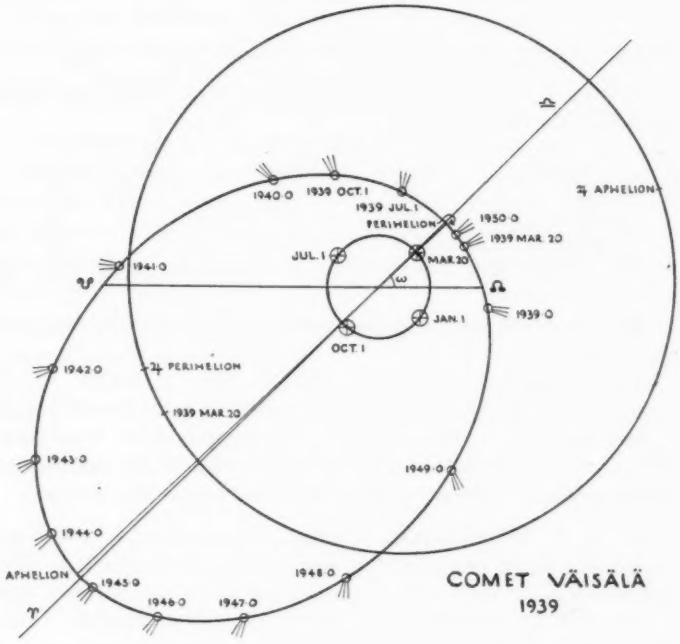
T	1939, April 10.17137 U.T.	
q	0.528156	
ω	89° 15′ 11″.2	1939.0
Ω	311° 26′ 19″.3	
i	138° 04′ 31″.9	

The relation of this orbit to that of the earth is illustrated in the accompanying diagram. The comet's orbit is in the plane of the paper, and the indicated orbit of the earth makes the angle $i = 138°$ with this plane.

The ephemeris of this comet is as follows:

	R.A. 1939	Dec.	Distance from Earth	Distance from Sun
May 13	6^h 09^m 06^s	+28° 02′.3	1.378	0.902
17	19 40	+25 54 .9	1.509	0.969
21	28 13	+24 05 .5	1.638	1.035
25	35 23	+22 30 .4	1.761	1.102
29	41 33	+21 06 .5	1.881	1.169
June 2	6 47 00	+19 51 .6	1.995	1.236

This comet has been readily observable with field glasses or a small telescope.



Comet 1939c (Väisälä).

The elements of this comet have now been published, as determined by students in the Berkeley Astronomical Department, of the University of California. The comet is moving in an elliptical orbit, with a period of 10.7 years.

T	1939, March 20.09870 U.T.	e	0.637066
M	−3° 36391	μ	0°.091725
ω	44° 4′ 20″.9	a	4.86944
Ω	135° 24′ 41″.3 (1939.0)	P	10.7453 years.
i	11° 19′ 24″.3		

The accompanying diagram shows the relative positions of the

orbits of this comet, the earth and Jupiter. The orbit of the comet is in the plane of the paper.

F.S.H.

NOTES FROM THE DOMINION ASTROPHYSICAL OBSERVATORY

For the first three months of the present year we have the following observing statistics:

	1939		20-year average	
Month	Nights	Hours	Nights	Hours
January	10	59	10	64
February	15	73	13	91
March	18	115	16	96

The quarter was just about the average, then, as to observing conditions.

The number of visitors to the observatory during the three months was 1,040.

Her Excellency, Lady Tweedsmuir, was a visitor to the observatory on the evening of April 1st, after the usual Saturday night visitors had gone. The moon was the principal object shown and, while it was a little past the best phase for observation, nevertheless seeing conditions were good and a satisfactory view was obtained.

Dr. J. A. Pearce expects to attend the meetings of the Royal Society of Canada which are this year held in Montreal. It is likely that he will go by the southern route taking in the ceremonies in connection with the opening of the McDonald Observatory in Texas. The members of the staff have a total of seven papers for presentation at the Montreal meeting.

The Singer-Polignac Foundation is organizing an Astrophysical Congress to be held in Paris next July. The subject under discussion will be "Novae and White Dwarfs". Dr. C. S. Beals of the staff of this observatory has been invited to prepare and present a paper on "Wolf Rayet Stars, P Cygni Stars and Supergiants of Class A". It is a distinct tribute to his leadership in this phase of astronomical research and his colleagues are happy in extending their congratulations.

The tree planting mentioned in the January issue as a piece of

work that might be done has actually materialized. About 18,000 seedlings of fir and pine were set out early in March by the Provincial Forestry Department using the services of the single unemployed men. It is expected that about 75 per cent of these will survive and in ten years' time it is thought they will be about eight or nine feet in height. This will make a decided improvement in the appearance of the Hill, to say nothing of possible improvement in "seeing" conditions.

An all-concrete seismograph vault has been recently constructed in which it is expected to house some of the latest and most sensitive earthquake instruments. The work has hitherto been carried on at the Meteorological Station at Gonzales, but when the instruments are installed here that work so capably carried on by Mr. W. A. Thorne in the past few years will cease.

Born—To Dr. and Mrs. R. M. Petrie on February 21st—a daughter, Patricia Joyce.

W. E. H.

MEETINGS OF THE SOCIETY

AT VICTORIA

February 8, 1939.—A regular meeting was held, 8.15 p.m., in the Y.W.C.A. The president, Mr. Robert Peters, was in the chair. Three new members were welcomed to the Society: Mr. J. Noble, Mr. H. A. W. Brown, and Mr. W. Stilwell. All members were urged to avail themselves of the question box, where questions may be deposited to be answered at the following meeting.

The speaker of the evening, Dr. C. S. Beals, was introduced by the president. Dr. Beals first explained the meaning of his topic "The Age of Giants". He stated that the age referred to was the period from the end of the 15th to the beginning of the 18th century, during which time the transition was made from the medieval to the modern mind. The appropriateness of the title is understood when we realize that these years were studded with astronomers of such intellectual achievements as to be considered giants in their field of study.

Some of the "giants" discussed by Dr. Beals were as follows:

1. *Leonardo Da Vinci*—principally famous as a painter and musician, he was an architect, a civil engineer, an experimenter in physics and chemistry and an observer of the heavens.

2. *Nicolaus Copernicus*—known as the father of modern astronomy, he showed that his heliocentric system pointed out the only solution to the motions of several different planets.

3. *Tycho Brahe*—probably the greatest observational astronomer of all time, was born three years after the death of Copernicus.

4. *G. Bruno*—a Dominican monk, and the foremost philosopher of the renaissance, advocated the doctrines of Copernicus.

5. *Galileo*—recreated and improved upon the telescope invented by an optician in Flanders. This astronomer is known as the father of modern mechanics and of modern observational astronomy.

6. *Johannes Kepler*—laid the foundations for integral calculus, propounded the three famous laws of motion of the planets, and developed tables that were the forerunners of the nautical almanac today.

7. *Sir Isaac Newton*—recognized as the greatest scientific genius of all time, his discoveries were a culmination of all previous experiments.

The lecture was illustrated with interesting slides of these and other astronomers and their work.

Cordial thanks were given Dr. Beals for his very informative address. The meeting adjourned at 10.05 p.m.

PHOEBE RIDDLE, *Recorder.*

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The Society has active Centres in Montreal, P.Q.; Ottawa, Toronto, Hamilton, and London, Ont.; Winnipeg, Man.; Edmonton, Alta.; Vancouver and Victoria, B.C.

The Society publishes a monthly JOURNAL containing each year about 500 pages and a yearly OBSERVER'S HANDBOOK of about 80 pages. Single copies of JOURNAL or HANDBOOK are 25 cents.

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The Society has for Sale:

Reprinted from the JOURNAL of the Royal Astronomical Society, 1936-1937.

The Physical State of the Upper Atmosphere, by B. Haurwitz. Pages 90; Price 50 cents postpaid.

The Small Observatory and its Design, by H. Boyd Brydon, 48 pages; Price 25 cents postpaid.

General Instructions for Meteor Observing, by Peter M. Millman, 18 pages; Price 10 cents postpaid.

Meteor Photography, by Peter M. Millman, 16 pages; Price 10 cents postpaid.

General Index to the TRANSACTIONS of the R.A.S.C., 1890-1905, and the JOURNAL, Vols. 1 to 25, 1907-31.

Compiled by W. E. Harper, Assistant Director, Dominion Astrophysical Observatory, Victoria, B.C., 122 pages, Price $1.00 postpaid.

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